

# Food quality and processing

A summary of research conducted under the German Federal Programme for Organic Agriculture and other forms of Sustainable Agriculture

## BÖLN

Bundesprogramm Ökologischer Landbau  
und andere Formen nachhaltiger  
Landwirtschaft



# Summary of research results of the German Federal Programme for Organic Farming (BÖLN), 2001-2011

This series of thematic summaries arose from the project 10OE027 „Evaluation of the German Federal Research Programme on Organic Agriculture“. The evaluation was funded by the German Federal Programme for Organic Farming

Conducted by the contractor group Organic Research Evaluations:

**Interval GmbH, Berlin, Germany**

**Organic Research Centre - Elm Farm, Newbury, United Kingdom**

**University for Sustainable Development, Eberswalde, Germany**

In collaboration with: **Dr. Donal Murphy-Bokern**

1. Soil fertility – <http://www.orgprints.org/21868>
2. Plant protection in organic arable and horticultural production - <http://orgprints.org/21869>
3. Plant protection in organic apple production - <http://orgprints.org/21875>
4. Nutrition of monogastrics - <http://orgprints.org/21874>
5. Animal health of ruminants - <http://orgprints.org/21872>
- 6. Food quality and processing - <http://orgprints.org/21871>**
7. Knowledge transfer - <http://orgprints.org/21870>
8. Regional marketing - <http://orgprints.org/21873>

From: Ekert, S, Döring, T, Häring, AM, Lampkin, N, Murphy-Bokern, D, Otto, K Padel, S Vieweger, A (2012) Final report (Project 10OE027) „Evaluation des Bereichs Forschung und Entwicklung im Bundesprogramm Ökologischer Landbau“ [Evaluation of the German Federal Research Programme on Organic Agriculture], Organic Research Evaluations: Berlin, Eberswalde and Hamstead Marshall, Annex I-XIII, Page 66-68.

Bundesanstalt für Landwirtschaft und Ernährung (BLE), Deichmanns Aue 29, 53179 Bonn

Organic Research Centre, Elm Farm, Hamstead Marshall Newbury

**December 2012**

## 1. Introduction

The German Federal Programme for Organic Agriculture (BÖLN) was founded in 2001, with the goal of improving the conditions for organic farming and food industry in Germany, and to achieve the conditions for a balanced growth of supply and demand. The programme is funded by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), and implemented and coordinated by the Federal Agency for Agriculture and Food (BLE) in Bonn. Since 2008, the programme is part of the German National Action Plan (2005-2014).

Since the beginning of 2011, the second evaluation of the programme (project ID 09OE027) is carried out by the international contractor group Organic Research Evaluations; consisting of the partners InterVal GmbH in Berlin, The Organic Research Centre, Elm Farm, United Kingdom and the University for Sustainable Development in Eberswalde, Germany.

The focus is on the programme of the BMELV to support research projects in organic farming, where more than 650 projects have been funded since 2002. The evaluation is in particular to clarify the extent to which research results helped to strengthen organic agriculture in Germany and expand its market share. The evaluation results, which are expected to be publically available in early 2013, shall also benefit a future optimisation of research funding.

The summaries of research results in eight focus topics (soil fertility, plant protection in arable and horticultural production, plant protection in apple production, nutrition of monogastrics, animal health of ruminants, food quality and processing, regional marketing and knowledge transfer) from the whole period of the programme since 2002. All projects can be identified with the individual project ID number, shown in brackets in the title; and following the link below, further information can be found on the German BÖLN website. Where available, links to the final-reports of individual projects on the Organic Eprints website are added. Further results of running projects of the BÖLN research programme are regularly published at [www.bundesprogramm-oekolandbau.de](http://www.bundesprogramm-oekolandbau.de).

## 2. Summary

Food quality has been a strong focus of the BÖL research programme since it started in 2001. Among other things, the policy on EU organic regulations was supported with research projects; for example regarding the discussion concerning the admission of meat curing agents (nitrite and nitrate) in 2006. In a project on this subject, consumer acceptance of cured meat products, not using these curing agents, has been described as surprisingly positive, and the practical use of alternative materials and technologies was evaluated. It was found that the implementation of new technologies to reduce the use of curing agents was mainly inhibited by their lacking acceptance in practice, technical adaptation needs and investment in product development as well as disputed legal issues. As part of another project, a guide for processors was created, within which the new methods and solutions were presented.

To enhance knowledge transfer regarding the new EU hygiene standards for organic meat processors in 2008, a number of general information and specific documents for the admission application as well as templates for the necessary internal controls were developed.

The general use and suitability of new organic food additives were also examined. Different substances, which could serve as binding agents or antioxidants, were tested. Locust bean gum, guar gum, xanthan and agar agar showed a sufficient bond-stabilising effect without affecting the sensory quality of the products. Substances such as ascorbic acid, citric acid, rosemary extract, ginger and lemon juice showed a satisfactory effect against oxidative browning reactions. Furthermore, the use of rye sprouts as an ingredient in wheat bread produced very positive results: a study found that the volume, crumb firmness and crumb elasticity could be improved. The use of ingredients from yam (*Dioscorea batatas*) was investigated regarding the potential sensory and health benefits for flour blends. In another project, the use of yeast extract in organic foods was reviewed. It was shown here that there is very little research about the components and nutritional effects of yeast extract; also a survey among experts could not come to a clear formulation of conclusions. Thus, it was recommended that each processor should decide for or against the use of yeast extract in each particular case. Since 2008, an additive list is now being published annually and a website has been created where the manufacturers of additives can register themselves and sign up their organically certified and non-certified commercial products for evaluation.

The data from the National Nutrition Survey II (NVS II) in 2010 were analysed in detail, looking at organic buying habits in relation to socio-demographic characteristics, parameters of health and nutrition behaviour as well as food

consumption. Over 13,000 participants, aged between 18 and 80 years, were included in this survey. The derived recommendations show considerable potential. It was found for example, that organic buyers compared with non-organic buyers are more likely to lead a healthier lifestyle. Altruistic buying motives, such as interest in fair trade, animal welfare and the renunciation of the use of genetic modification, have been identified as a central driver of organic buying behaviour. It was also recommended, in addition to ethical arguments, to integrate health benefits more directly into the marketing of organic food.

### 3. The individual projects

#### Curing agents in organic meat products (04OE003/1) 01-04-2005 to 30-09-2006 <http://orgprints.org/10466/>

The implementation of the new EU Organic Regulation (64458/AGRI/2003-DE) led to a task that was the content of this project proposal. Quote: 'The adoption of sodium nitrite and potassium nitrate in Annex VI, Part A.1 will be re-examined before 31 December 2006; it will examine, in the light of the state of scientific and technical development, to what extent alternative technical methods can be adopted for the processing of meat products from organic farming, that have adequate hygienic safety, while preserving the characteristics of the product, such that the use of these additives (sodium nitrate and potassium nitrate) can be limited or prohibited.' Crucial questions were formulated at this point, whose answers were considered a basis for discussion on the approval of nitrite and nitrate beyond 2006. In a study on consumer acceptance of sausages without a curing agent (potassium sorbate, PS) a surprisingly good acceptance of these products was found. Introducing an assortment of meats without curing agents had a positive effect on the sale of the entire organic sausage/cold meats range in stores. Moreover, the project tested the applicability of alternative technologies for the elimination or reduction of the use of curing agents. Evidence was found in the literature of technologies that work without PS or with a reduction in its use, which do not produce a reddening of the meats. Implementation in practice was slowed by problems such as the acceptance of these alternative technologies, technological adaptation needs and investment in product development as well as disputed legal issues.

#### Sodium nitrite in raw sausage products (04OE003/1F) 01-01-2006 to 28-02-2008 <http://orgprints.org/14568/>

The aim of this project was the scientific review of the microbiological properties of nitrite as a curing agent for raw sausage. Investigations with major foodborne pathogens (*Salmonella* spp., *Listeria monocytogenes*, *Escherichia coli* EHEC/STEC) were carried out in culture media and in challenge experiments with raw sausage. From these data advice/rules for the safe production of raw sausage products and for the necessity of the use of sodium nitrite were derived. The study showed that sodium nitrite has an antimicrobial effect only in combination with a low pH. In none of the tested products was *Listeria monocytogenes* completely eliminated. However, *Escherichia coli* and *Salmonella* spp. were reliably killed, especially in the long-aged products, due to the strong drying of the product. Because of its growth in the products and its ubiquitous occurrence, especially in meat processing plants, *Listeria monocytogenes* forms the greatest danger in raw sausage production. A thorough examination of the raw materials, constant hygiene monitoring, as well as an addition of 100 mg/kg sodium nitrite were therefore recommended.

#### Reduced use of curing agents (06OE007) 01-04-2007 to 29-02-2008 <http://orgprints.org/14275/>

The project objective was to improve the theoretical knowledge of practitioners such that they could produce organic meat and sausage goods without, or with a reduced use of nitrite (nitrite pickling salt, NPS). The safe and technologically flawless production of meat and meat products with reduced NPS content or without NPS requires custom manufacturing technologies and relevant expertise. Compliance with certain parameters for individual production steps is required for product quality and safety. Practitioners often lacked this knowledge, so that it was not possible for them to produce high-quality and safe food with no or a reduced amount of curing agents. The purpose and aim of the guide produced as a result of this project was to provide advice to processors so that they could produce nitrate-free products or products with reduced amounts of curing agents with an appropriate technology. In this guide, key measures and appropriate solutions are presented.

#### Development and identification of suitable additives (06OE248) 04-05-2007 to 30-04-2009

<http://orgprints.org/16467/>

The project aimed to develop the production technology for organic ready meals and convenience products and improve their quality. The focus was on cook-and-chill ready meals as well as sauces and soups in small and large sizes, and further on the possibility of preservation of fresh vegetables and salads in a modified atmosphere. This study analysed substances such as locust bean gum, guar gum, xanthan and agar agar, which in product-specific concentrations showed a sufficient bonding and stabilising effect without adversely affecting the sensory profile of the



sample. In the context of the second phase of the project, the identification of antioxidants for use in the packaging of fresh-cut organic salads and vegetables, samples were treated during the cleaning process with ascorbic acid, citric acid, rosemary extract, ginger and lemon juice and analysed after 5, 7 and 9 days in terms of sensory and microbiological properties. The results regarding ascorbic acid, citric acid and lemon juice showed a demonstrable improvement in the stability of the products against oxidation-induced browning reactions. In the third priority area of the project, the optimisation of packaging and gas combinations, experiments were performed with materials based on polyamide-polyethylene (PA-PE) composites, polypropylene and the organic synthetic polylactide acid. Gas mixtures with different proportions of carbon dioxide, oxygen and nitrogen, or with inclusion of different amounts of argon, showed a distinct, different effect on the perceived freshness of the product. The PA-PE materials in combination with a protective gas mixture with a residual oxygen content of 5% showed the best sensory and microbiological influences on the shelf-life of the products.

#### Critical control points within the whole food chain (07OE001) 15-06-2007 to 30-06-2010

Organic production covers the entire process chain from field to fork, but while the EU regulation (EU 2092/91) describes the cultivation stage in detail, it has lacked up to now, information on the processing of organic foods. Process steps had to be examined for their impact on food safety and quality. A suitable analysis method was the critical control points (QACCP) approach. The transnational project (CORE Organic) has investigated the quality of a selected processed food based on an analysis of quality-determining steps throughout the whole processing chain. The aim was to analyse both the production (in terms of authenticity) and the processing (regarding authenticity and sustainability) and to test the products for safety, quality and health. The carrot was chosen as an example product, because it is widely grown in organic farming. In addition, it was examined to what extent the results can be transferred to other foods. For processing, the production of baby food was selected. The project has built up a network of European research institutes, associations and companies from different disciplines and could thus be a contact point for future projects in this area. The results provide valuable information on the importance of organic food for human health and show how processes can be optimised.

#### Use of yeast extract in organic food (08OE073) 01-12-2008 to 31-12-2009 <http://orgprints.org/17187/>

The first objective of the project was to determine whether there were scientific or fundamental objections to the use of yeast in processed organic foods. Furthermore, it was explored whether for certain products the use of alternative ingredients was applicable and whether they satisfy the existing requirements for sensory effects, nutritional physiology and production technology. The technical feasibility of using alternative ingredients was also studied as part of the project. Yeast extract, as an ingredient in organic foods, has been increasingly critically perceived by the media and consumers. It is presumed that yeast has similar effects as those discussed for synthetic flavour enhancers. Even representatives of the organic food industry perceived yeast extract as an ingredient that is inconsistent with the need for natural purity of organic food. But due to lack of data, no conclusions could be drawn for or against the use of yeast extract in organic foods. Also, a survey of experts revealed no further information as to a scientific evaluation, and extensive chemical and biochemical studies would be necessary. To fulfil the claim of naturalness of organic food and to meet consumer expectations yeast extract should not be used in organic foods. From a manufacturer's perspective, this is not possible for all products. On the basis of these facts, therefore, every company should make an individual decision for each of its products. This project indicated the need for research to assess the characteristics and effects of yeast extracts and to develop viable alternatives.

#### Implementing requirements of the hygiene regulations (07OE042) 01-06-2008 to 30-06-2010

<http://orgprints.org/17298/>

This project aimed to initiate a transfer of experience and knowledge regarding the application of the new EU hygiene regulations, targeted at organic meat producers and processors, to provide assistance in obtaining the EU approval that is now required. The companies were informed about the new law and about the EU regulatory practices of the provinces and district authorities. In addition, specific documents for the admission application and templates were developed for the required internal controls. Through parallel advising of companies regarding the EU approval and feedback of the experience with regulatory authorities, these documents were tested for their suitability and continuously improved. Through a close link between research and application a new research approach was established, which included the practice both in the development of the questions and in the whole research process. The results have been obtained from the immediate implementation of lessons learned.

#### Technical ingredients, food additives and processing aids (06OE168) 01-05-2008 to 30-06-2010

<http://orgprints.org/17363/>

In this project, a system for the assessment of commercial products that are used in the processing of organic foods was to be developed and established. The results were published in the form of a printed list of additives. About 600 manufacturing firms were contacted and a telephone survey addressed the 120 major manufacturers personally. Positively assessed products are listed continuously in the annually published FiBL-list, 'organic processing', for the organic food industry. On the website [www.zusatzstoffe.org](http://www.zusatzstoffe.org) manufacturers of additives, processing aids and ingredients with technological functions can register themselves, and (using a PDF form) list both organic certified and non-certified commercial products for evaluation.

#### Sprouted grains as a novel, multifunctional ingredient in baked goods (06OE167) 15-11-2008 to 31-12-2010

<http://orgprints.org/18230/>

The aim of the project was to professionalise and increase the use of sprouts (germinated grain) as a functional ingredient in bakery products in organic bakeries. For this purpose, the study addressed the hygienic conditions of the production of rye and spelt sprouts in a typical bakery environment. The general recommendations were summarised in a guide for bakeries. To get even baking results, sprouts with consistent quality are needed. Quality-determining factors are microbiological contamination, the value-adding ingredients and enzymology. From the results a rule of thumb '15:15:30' was derived: a layer of 15 cm, a maximum germination temperature of 15°C and a germination period of 30 hours can achieve the best germination results. During germination a significant increase of enzyme activity can be registered. This enzyme activity is particularly technologically relevant for rye dough. It is recommended that the sprouts are crushed as late as possible and rather crudely added to the well soured or leavened dough. The use of rye sprouts as an ingredient in wheat bread can produce very positive results. The crushing ratio of sprouts has a decisive influence on the quality of manufactured wheat bread. Overall, the volume, elasticity and stability of the crumb were improved.

#### Alternative additives for organic products (yam) (08OE027) 15-12-2008 to 31-03-2011

The aim of the project is to develop organic ingredients from the yam root (*Dioscorea batatas*). The ingredients are used for sensory and health improvement of flour blends that can be used in the production of organic bread, pastries and pasta. On the one hand, ecological horticulture can benefit from the innovative use of *Dioscorea batatas*; on the other hand its use opens new perspectives to industrial organic bakeries.

#### Analysis of the data of the National Nutrition Survey II (08OE056, 08OE069) 01-02-2009 to 31-08-2010

<http://orgprints.org/18055/>

The aim of this project was to identify the potential for organic food. For this, the data from the National Nutrition Survey II (NVS II) was used to characterise the organic buying behaviour of different groups within the general population. The groups were described in more detail in terms of their health and eating habits, attitudes, and by sociodemographic characteristics, in order to identify different dietary patterns and overall behavioural styles in combination with the organic eating habits. In the light of the increase in nutrition-related diseases in Germany, it was further investigated whether a higher consumption of organic products is linked to an overall healthier lifestyle. Over 13,000 participants aged 18 to 80 years were included in the analysis. Almost half of the respondents claimed to buy organic food. Compared to men, women buy a larger proportion of organic food, while young adults aged 18 to 24 years show the least interest in buying organic. Among the organic buyers a higher proportion of normal-weight (fewer cases of overweight/obesity), non-smoking, athletic and active people, those with good nutritional knowledge and people who assess their health as very good or good are found. This descriptive characterisation of organic buyers in comparison with the non-organic buyers showed that organic buyers tend to have a healthier lifestyle than non-organic buyers. Major influences on the organic buying behaviour are psychographic factors (such as environmental awareness and sustainability-related issues). They explain a lot more than the demographics. Altruistic buying motives, such as fair trade, animal welfare and the renunciation of the use of genetic engineering in food, have been identified as a central driver of organic buying behaviour. The typology shows that for both the organic buyers and the non-organic buyers of both sexes clear correlations exist between a cheaper choice of food (rich in fruit or vegetables) and a sustainability-oriented attitude (emphasis on issues such as animal welfare, no GMO, fair trade). It was also recommended, in addition to ethical arguments, to integrate health benefits more directly in the marketing of organic products. At the same time, even if organic buyers eat less meat, there is potential for market development for organic meat, especially with regard to the male consumer. The recommendations derived show that a considerable potential exists and that in this area politics, industry, trade and consumer advice can contribute significantly.